No. 3

PINK BOLLWORM INFORMATION

COOPERATIVE RESEARCH ON THE PINK BOLLWORM AND RELATED COTTON INSECTS

Distributed occasionally by
the Pink Bollworm Research Center,
Brownsville, Texas

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P I N K B O L L W O R M I N F O R M A T I O N

N O. 3

Introduction: This, the third circular of information, comes to you for the purpose of keeping you informed of recent developments in the pink bollworm situation and in the research program on the pest. It is limited in its distribution to state and Federal officials and researchers directly concerned with the pink bollworm problem.

Although the information contained in this brochure relates to work done since October 26, 1954, when PINK BOLLWORM INFORMATION NO. 2 was issued, some reference to earlier work has been included so as to make less necessary reference to previous reports.

This progress statement is relatively short and it is our hope that it will be read in its entirety by each of you. Please read it critically and pass any suggestions for its improvement on to the Center. Especially, it is desired that ideas on new approaches to the problem or changes in stress on lines of research underway be brought to our attention.

Financial Support: There has been no change in the financial status of the program. The bill making appropriations for the work of the Department of Agriculture has been passed by the House of Representatives which provides for an increase of $15,000 for pink bollworm research for the fiscal year beginning July 1, 1955. The Senate Committee restored the original budget figure of $30,000. It remains for the Joint Conference Committee to act on these differences. Plans are being made to use this increase to employ an insect toxicologist and an insect pathologist at Brownsville; and if the higher amount is made available to employ an entomologist at Lubbock, and expand the bioclimatic cabinet studies.

The appropriations from the States of Georgia and Alabama terminate on June 30, 1955, unless action is taken to continue support from those sources.

Facilities and Grounds: A request for an additional strip of ground 100 feet wide along the west side of our present area has not been acted upon as yet. It is anticipated that additional space will be needed since it is now necessary to vacate the old motor pool building and to provide housing for a shop, insecticide mixing, and storage.

Two bioclimatic cabinets belonging to the U.S.D.A. and three belonging to the State of California have been received in Brownsville and are now in storage. Plans for reconditioning these cabinets, including the installation of a large compressor to provide for a double, rather than the present refrigerating unit have been submitted to Washington for approval. Plans for construction of a building similar to the one occupied by the bioclimatic cabinets now in operation are going forward. Funds for beginning construction of this building this fiscal year were made available by the Agricultural Research Service. It will be constructed close to the present building so that the present operating crews can expand their work with little additional help. Provision for these additional cabinets will permit considerable expansion of the biological studies on citrus fruit insects and the pink bollworm.

With funds provided by the Alabama Experiment Station a screen cage 9 x 40 feet with work benches has been constructed to provide for experiments with pink bollworm attractants and repellents.

Additional equipment has been provided for the conduct of insecticide screening work and cages for out-of-door tests of insecticides; also some minor equipment for the insect physiology laboratory.

Cooperation: The valuable cooperation of agencies mentioned in previous issues has continued.

The Arkansas Agricultural Experiment Station, under the direction of Dr. Charles Lincoln, has arranged for some research on the pink bollworm problem with a view to developing control measures fitted to Arkansas. Dr. Thomas F. Leigh is presently employed full time on the pink bollworm project in Arkansas and Mr. Jack Sherrer is continuing studies on several problems at the Port Lavaca substation. Drs. M. L. Ray and O. T. Stallcup of the Department of Animal Industry are cooperating in studies of the utilization of cotton residues by grazing the fields after harvest and by preserving the residues as silage. The harvest of field residues for use as low-grade roughage offers promise as a method of field cleanup. A survey of Arkansas is being made to determine the presence and distribution of malvaceous plants that might serve as hosts for the pink bollworm. Seeds of some of these have been collected and sent to the Port Lavaca laboratory for propagation and exposure of the resulting plants to pink bollworm attack. Dr. Lincoln also reports progress on control of boll weevil and other cotton insects by weekly applications of insecticides with special attention to late season treatments, the object being to adjust the control program for other insects to fit the schedule that will be required to combat the pink bollworm.

The Alabama Experiment Station is continuing to pay the salary of J. A. Griffin and to supply him with some funds for equipment and miscellaneous expenses as well as to finance some other activities at the Brownsville laboratory.

The funds provided by Georgia and Mississippi are also going into various aspects of the accelerated research project at Brownsville with emphasis on phases of the program that are thought to be of most direct

value to those states. Results of the investigations supported by these states and Alabama are discussed along with the activities of the Pink Bollworm Research Center and Sublaboratories.

The Louisiana Experiment Station, under the direction of Dr. L. D. Newsom, is continuing its study of the distribution of Hibiscus and other possible hosts of the pink bollworm in that state. Mr. J. R. Brazzel's research on the problem of pink bollworm resistant cottons is carried on at College Station, Texas, with Louisiana funds.

Pink bollworm research financed by the Texas Experiment Station is covered in the report prepared by that station which appears in subsequent pages.

The annual allotments from the Oscar Johnston Cotton Foundation continue to be made available to the Center through the U. S. Department of Agriculture.

Several states, including Arkansas, Louisiana, and Mississippi, are operating ultra-violet light traps for the detection of the pink bollworm and to gather information on the seasonal abundance of various pests of cotton and other crops.

The participation of the Texas Ginners' Association and of a number of individual ginners in studies of the efficacy of gin equipment in killing the pink bollworm made those studies possible, and is greatly appreciated. Acknowledgment is also made of the assistance lent by operators of certain cottonseed oil mills and cotton seed delinting plants in the conduct of studies in those fields.

Meetings Attended by Brownsville and Sublaboratories Personnel: During the winter and spring a number of important meetings relating to cotton insect problems were held and an effort was made to have representatives

of the pink bollworm research staff attend most of these for the purpose of presenting information on the research program and to gather information and make contacts needed in the conduct of the research program. The following is a list of the meetings and those attending:

International Conference on Control of Pink Bollworm and Other Cotton Insects, San Antonio, Texas, Oct. 25-26: F. C. Bishopp, S. E. Jones, and A. J. Chapman.

Eighth Annual Cotton Insect Control Conference, Dallas, Texas, Nov. 29 - Dec. 4: F. C. Bishopp, S. E. Jones, A. J. Chapman, L. W. Noble, E. W. Clark, R. L. McGarr, C. A. Richmond, O. T. Robertson, and G. L. Smith.

Annual Meeting of the Entomological Society of America, Houston, Texas, Dec. 5-9: F. C. Bishopp, S. E. Jones, A. J. Chapman, L. W. Noble, E. W. Clark, D. S. Chadbourne, P. A. Glick, C. A. Richmond, M. J. Lukefahr, J. A. Griffin, Ivan Shiller, W. J. Eitel, Jack Sherrer, P. S. Messenger, and G. W. Angalet.

Ninth Annual Beltwide Defoliation Conference, Memphis, Tenn., Jan. 12-15: F. C. Bishopp.

Annual Meeting of National Cotton Council, Houston, Texas, Jan. 30-Feb. 1: S. E. Jones.

Annual Chemical Control Conference, Lubbock, Texas, Feb. 1-2: F. C. Bishopp and O. T. Robertson.

Thirty-eighth Annual Convention of Oklahoma Cotton Ginners' Association, Oklahoma City, Okla., Feb. 23-24: F. C. Bishopp.

Western Cotton Production Conference, Phoenix, Ariz., Mar. 7-10: F. C. Bishopp.

Conference of Cooperators of the Southern Regional Laboratory, New Orleans, La., Mar. 21-23: F. C. Bishopp.

Southern Regional Meeting of Texas Academy of Science, Brownsville, Texas, Apr. 15-16: N. E. Flitters, M. J. Lukefahr, P. A. Glick, and F. C. Bishopp.

Personnel: P. S. Messenger (Ph.D., U. of Calif.), an employee of the California Experiment Station who had been working on the cooperative Oriental Fruit Fly Project in Hawaii, came to Brownsville on November 19 to continue similar cooperative studies on the Mexican fruit fly involving the operation of bioclimatic cabinets. On January 7, N. E. Flitters of the Fruit Insects Section returned from Honolulu for permanent duty at Brownsville. He had spent a few months previously at the Pink Bollworm Research Center checking the bioclimatic cabinet installations. He will continue on the payroll of the Fruit Insects Section and will deal primarily with Mexican fruit fly studies. On January 31, Shuichi Masuda, who has been working on the bioclimatic cabinets in Hawaii, reported for duty in Brownsville. He, J. B. Woods, Ray J. Souder, Jose A. Tamayo, and Eliuth C. Cantu, who are assigned to the night and day operation of the bioclimatic cabinets, are paid by the Fruit Insects Section. One man, J. E. Houghtaling, engaged in this work is paid by the Cotton Insects Section.

George Angalet of the Section of Insect Identification and Parasite Introduction, previously engaged in collecting parasites and predators of the pink bollworm in India, came to Brownsville on February 11 to assist during the summer on the biological control work. Mr. Angalet will assist in determining if the foreign parasites liberated last year have become established.

The following resignations and transfers have taken place: Edna Lee LaPierre, December 3; Don Morris, March 23; D. S. Chadbourne, March 25; and J. W. Davis transfered to Waco laboratory, April 1. The following

appointments have been made: Rafaela Guerrero (clerical) January 17; Lillian Borja (clerical) April 27; Diego Mayans and Mike Marroquin (laborers unallocated) January 3.

Visitors: Some 300 people including, among others, manufacturers and dealers in agricultural chemicals, farm machinery, gin equipment, the agricultural press, extension workers, teachers, students, farmers, and scientists have visited the Pink Bollworm Research Center during the last six months. During this period representatives of a considerable number of Branches of the U.S.D.A. came to the Center to see the facilities and discuss the organization and the research underway. Several representatives of U.S.D.A. Citrus Advisory Committee visited the Center on February 11.

Laboratory leaders of the Cotton Insects Section met with K. P. Ewing, Head of the Section, at the Center February 14-18 for a thorough discussion of research projects and for laying plans for uniform beltwide insecticide tests.

On February 3 several Missouri State Senators and Representatives and members of the staffs of the State Agricultural Experiment Station and Extension Service of Missouri visited the Center to obtain information about the pink bollworm problem and steps that Missouri might take to protect the State against the pest.

Several groups interested in the work of the Center have been among the visitors. These include the Brownsville Management Club, the Cameron County Nurserymens' Association, and the South Texas Region of the Texas Academy of Science.

Among the foreign visitors were Mr. Soepartono Siswopranoto, Ministry of Agriculture, Bogor, Indonesia, March 14-18; and Dr. Zvi Avidov, Senior Entomologist, Ministry of Agriculture, Rehovot, Israel, April 4-8.

PINK BOLLWORM CONTROL PROJECT (R. W. White and F. I. Jeffrey)

Status of Pink Bollworm Control, as of May 1, 1955: The Pink Bollworm Control Program continues to keep economic damage by that insect to a satisfactorily low level through suppression of infestation and by retarding the spread. About two-thirds of the cotton production of the United States is still free from infestation, after 37 years of control procedures. Economic damage within the remaining one-third was confined to individual localized areas and fields.

Although the controls used have been reasonably successful, the potential threat to the industry has increased rather than diminished. The outstanding need for improvement in the program is for (1) 100 percent kill of pink bollworms in seed cotton by some economical means during the process of ginning, and (2) a higher percentage of kill of overwintering pink bollworms in the process of stalk destruction and preparation of land after harvest. Improvement in these two procedures will greatly strengthen the program.

Following our last report, inspection surveys to determine intensity of infestation and spread of the pink bollworm in the 1954 crop were continued until the middle of December 1954. New infestations were found in 3 counties of Arkansas; namely, Clark, Logan, and Yell. These 3 counties and 17 buffer counties were added to the quarantined area by State authorities. The cultural and regulatory procedures effective for the 1954 crop year are to be applied to this new area.

Results of surveys from January 1 to date to determine survival of pink bollworm in last season's crop residue which would infest the new crop, reveal that there has been a low survival rate in both the northeast Mexican cotton areas adjacent to the United States and in a group of 49

south Texas counties (Area 3). In Mexico the survival rate was found to be 2.17 live pink bollworms per 100 bolls inspected, compared to 6.67 in 1954. In the group of 49 south Texas counties, the rate this year is 3.68 compared to 11.88 last year. Only 9 counties of this group showed an increase.

In grouping 90 counties in central and east Texas (Area 4), results of inspection show that the survival rate is 8.04 pink bollworms per 100 bolls this year, compared to 4.08 last year. This year's figures are based on the inspection since January 1 of debris and bolls from standing stalks combined.

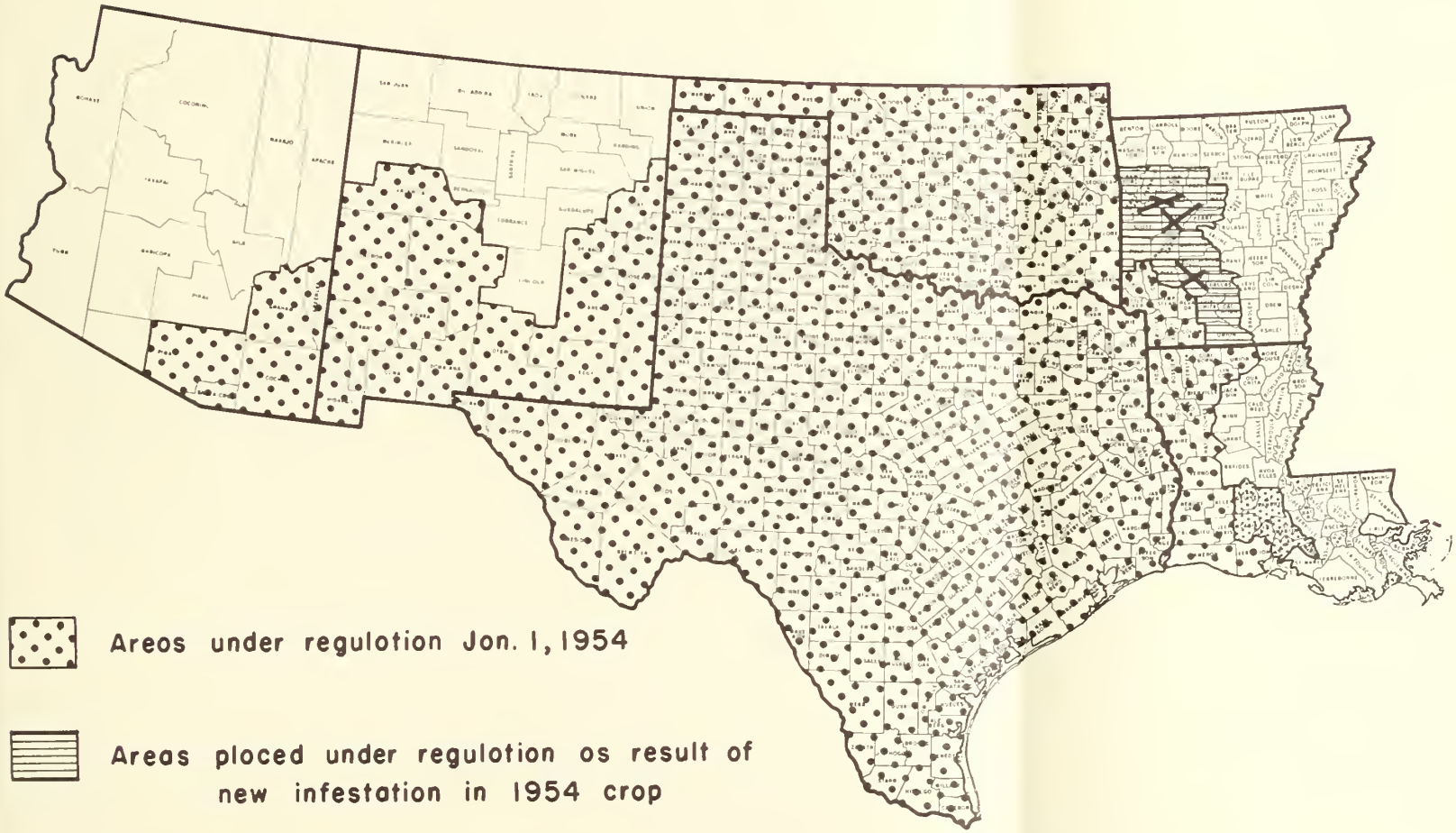
Due to the drouth conditions that prevailed over central Texas the past season, upland cotton was picked early and unusually clean. This condition caused a concentration of the infestation in late fields along the river and creek bottoms where the high carry-over has been found. Generally, over the area there is far less material left in the fields to contain overwintering pink bollworms than was the case the previous year. Another promising aspect, from a control standpoint, is the fact that all the early planted cotton for this year's crop was killed by the recent freeze, which should result in a uniformly planted crop over the entire area.

The Louisiana-Arkansas traffic inspection work was continued until late in the year. Louisiana closed its last station on December 31, 1954; Arkansas continued 2 stations until January 15; Mississippi continued inspection until February, the last station being closed on February 15, 1955.

Maintenance of the host free period in south Texas has been good to excellent. Unfavorable weather has ruined some stands of the new crop

PINK BOLLWORM REGULATED AREAS

JANUARY 1, 1955



Areas under regulation Jan. 1, 1954

Areas placed under regulation as result of new infestation in 1954 crop

Released from quarantine June 22, 1954

Pink bollworm found for first time during 1954 crop season in new regulated area

in some sections and set the remainder back approximately 2 weeks. Some dry land sections are awaiting additional moisture before replanting. The pink bollworm regulated areas and the three newly infested counties in Arkansas are indicated on the accompanying map.

Major shifts of Project personnel are being made this spring to danger areas of central and east Texas in an effort to prevent further buildup in those areas.

THE TEXAS AGRICULTURAL EXPERIMENT STATION (J. C. Gaines)

1. Development of Stalk Cutter-Shredders:

A. Rio Grande Valley Test: The following machines were tested:

(1) Modified Servis
(2) Modified Rotocycle
(3) X-1-Experimental Shredder with high speed fan attached
(4) X-2-Experimental Shredder with stripper units and crusher rolls attached

Machine X-1 was a complete mechanical failure and was excluded from all tests. Machine X-2 did not operate during the test because stripped bolls would not feed through the crusher rolls. Analysis of variance showed that the cutting operation of both commercial machines produced a significant reduction in pink bollworm moth emergence from residual boll material. There was no significant difference in population reduction between machines.

B. Gulf Coast Area Test: A forced feeding mechanism was adapted to machine X-2 and tests were conducted to compare the effectiveness of this machine in pink bollworm control with a modified Rotocycle. Analysis of variance showed that the cutting operation of both machines produced a significant reduction with emergence from shredded boll residues. There were no significant differences in shredder efficiency.

C. College Station Area Test: The following machines were used:

(1) Caldwell-Experimental Ensilage Harvester
(2) Rotocycle-Experimental Ensilage Harvester
(3) Servis-Modified Gyso 57
(4) Rotocycle-Modified Standard Machine for these tests
(5) John Deere-Experimental Ensilage Harvester
(6) X-2-TAES-Experimental Pink Bollworm Machine
(7) Case-No. 620 Utility Harvester (Production Model)

Analysis of variance showed the effect of cutting to be highly significant with the exception of machines (2) and (6) which produced insignificant mean differences between cutting samples. There were no significant differences between shredders.

D. Preliminary Tests in Mexico: A tractor-mounted experimental machine (X-3) has been fabricated using the principles of X-2 (Shredder with stripper unit and crusher rolls to crush stripped boll material). The stripper unit is much improved to give more efficient gathering of boll material. The crusher rolls are much greater in diameter making forced feeding of bolls through crusher unnecessary. The results of the field tests were excellent, from the stripping, crushing angle, but the one-row shredder that they were mounted on did not perform satisfactorily. Modification of this machine is now in progress.

M. G. Davenport, Agri. Engineer
W. J. Magee, Entomologist
G. P. Wene, Entomologist at T.A.E.S. Substation 15; F. C. Bishopp and L. W. Noble, E.R.B., U.S.D.A., assisted with tests conducted in the Rio Grande Valley

E. An experimental shredder based on the impact fan principal has been designed by personnel of Entomology Research Branch, U.S.D.A., Brownsville Pink Bollworm Research Center. It is being fabricated in Agricultural Engineering research shops, T.A.E.S., College Station, and will be evaluated in field tests this year.

2. Development of Sprayers and Dusters: The following nozzle arrangements and gallonages were used at Port Lavaca, Texas.

(1) Check - untreated
(2) Dust - 1 nozzle per row
(3) Dust - 2 nozzles per row
(4) Spray - 3-No. 2 nozzles per row; 6 gallons per acre
(5) Spray - 3-No. 3 nozzles per row; 9 gallons per acre
(6) Spray - 3-No. 6 nozzles per row; 18 gallons per acre
(7) Spray - 5-No. 2 nozzles per row; 10 gallons per acre
(8) Spray - 5-No. 3 nozzles per row; 15 gallons per acre
(9) Spray - 5-No. 6 nozzles per row; 30 gallons per acre

The dusts were dieldrin-DDT (2.5%-20%) mixtures applied at 15 pounds per acre. The sprays were dieldrin-DDT (1-2) mixtures with added DDT (2 lbs. per gallon) to give a total dosage of 0.5 pound dieldrin and 3 pounds DDT per acre. None of the dust or spray nozzle arrangements were better than the standard arrangement of three No. 2 nozzles per row in reducing pink bollworm damage or pink bollworm populations. The difference between pink bollworm injured bolls of DDT treatments and untreated checks was significant. The difference between larval populations of DDT treatments and untreated checks was highly significant. Treatment yield differences were not significant. A similar test was conducted near Weslaco, Texas, however, damaging pink bollworm populations did not develop. Two new high-clearance, self-propelled sprayers are being fabricated for use during the 1955 season.

W. J. Magee, Entomologist
G. P. Wene, Entomologist (Weslaco)
M. G. Davenport, Agri. Engineer

3. Resistance Studies: Seventy-five varieties of upland cotton are being screened in the field and in the laboratory at College Station, Texas, for resistance to the pink bollworm. Deltapine 15 and G. thurberi have been included in these tests as reference materials. In addition, all available species of cotton are being screened for pink bollworm resistance in the laboratory. Field test data have been analyzed. G. thurberi is

the only cotton tested that might exhibit some degree of resistance as indicated by analyses of variance.

Tests were conducted on larval habits which showed the existence of cannibalism and extreme irritability among pink bollworm larvae.

J. R. Brazzel, Grad. Asst. Ent.

4. Evaluation of Growth Inhibitors and Defoliants:

Experiment 1 - The following treatments were tested at Port Lavaca, Texas, in similar manner to the usual procedure for testing insecticides.

(1) Check
(2) Aerocyanamide
(3) Aerocyanamide and Aminotriazole
(4) Phillips #713
(5) Pentachlorophenol
(6) Sodium arsenite

Analyses of variance of infestation data showed no differences in pink bollworm damage or in pink bollworm populations between treatments.

Experiment 2 - The following treatments were tested at Port Lavaca, Texas, on cotton that was destroyed at 2 different intervals after application:

(1) Check
(2) Aerocyanamide
(3) Aerocyanamide and Aminotriazole
(4) Pentachlorophenol
(5) Sodium arsenite

The emergence of pink bollworm moths from boll residues in each subtreatment is being checked throughout the growing season of 1955. Analyses of emergence data for 1954 showed that differences in moth emergence between treatments were not significant. Differences in moth emergence between cutting dates were highly significant.

S. P. Johnson, Plant Physiologist
W. J. Magee, Entomologist

One of the regrowth inhibitors, aminotriazole, under test by the Station for the past three years will be commercially available in Texas this year. It will be marketed under the trade names Amizol and Meeno. The material is both a defoliant and a regrowth inhibitor. Various other regrowth inhibitors have been under test this past year. Other than the phenoxyproprionic derivatives, none have been found suitable for field testing this coming year.

S. P. Johnson, Plant Physiologist

5. Evaluation of Treatment Combinations for Pink Bollworm Control: The following treatments were tested on early and late planted cotton at Port Lavaca, Texas:

(1) Check - untreated
(2) Insecticide - (3 pounds DDT per acre)
(3) Defoliant (8 pounds Aerocyanamide + 0.5 pound Amino-triazole per acre)
(4) Insecticide & defoliant
(5) Shredders - (Modified Servis Model 57)
(6) Insecticide & shredder
(7) Defoliant & shredder
(8) Insecticide & defoliant & shredder

Analyses of variance of fleahopper and boll weevil infestations showed no significant differences between planting dates or treatments; analyses of variance of pink bollworm larval populations and of percent pink bollworm injured bolls showed highly significant differences between planting dates. Partitioned treatment sum of squares of percent pink bollworm injured bolls showed that the effect of insecticide was highly significant and that the effect of the interaction of insecticide and defoliant was significant. Partitioned treatment sum of squares of pink bollworm larval populations showed that the insecticidal effect was significant. Yield differences between planting dates and treatments were not significant. Analyses of variance of pink bollworm moth emergence during 1954 showed

significant differences between planting dates. Partitioned treatment sums of squares showed that the effect of shredding was highly significant in reducing pink bollworm moth emergence from crop residues.

W. J. Magee, Entomologist
S. P. Johnson, Plant Physiologist
M. G. Davenport, Agri. Engineer

6. Insecticide Tests for Pink Bollworm Control: A pink bollworm infestation developed in river bottom fields in Burleson, Brazos and Grimes Counties late in the season. Rains and irrigation water furnished sufficient moisture for the plants to put on a new growth and mature considerable fruit. This condition gave us an opportunity to test a new compound for pink bollworm control.

The experiment consisted of 16 plats including 4 treatments (check, compound 17147 and 2 dosages of DDT) each replicated 4 times. The first application of insecticides (dusts) was made September 10 when an average of 7% of the blooms were found infested. Seven applications of insecticides were applied at approximately 5-day intervals. The average infestations during the dusting period were: check, 31%; low dosage DDT, 20%; high dosage DDT, 24%; and compound 17147, 5%. These injury records indicate the effectiveness of the new compound. There were no significant differences between the yields of plats treated with the several materials.

The details of this test were reported and distributed in a Special Progress Report dated November 1, 1954. These data have also been summarized and submitted to the Journal of Economic Entomology for publication.

J. R. Brazzel, Grad. Asst. Ent.
D. F. Martin, Professor of Entomology
(College Station)

PINK BOLLWORM RESEARCH CENTER AND SUBLABORATORIES

Biological Studies of the Pink Bollworm - Line Project ENT f3-14 (M. J. Lukefahr and J. A. Griffin): Work on the biology of the pink bollworm has been somewhat handicapped by the lack of material. The development of the insect was materially slowed down in the large cage due to winter conditions and rearing moths from stored bolls was interfered with by mite infestations.

A sniperscope obtained from the military proved to be ineffective in watching the activities of moths in the dark. This equipment permitted one to see many objects in total darkness but the moths were not clearly visible.

Major attention was given to studies of the factors that initiate or terminate the larval resting stage since it is felt that a knowledge of this phenomenon might prove of great value in the control of this pest.

Toward the end of the cotton growing season, large numbers of pink bollworm larvae enter a dormant period and are called resting, or hibernating, larvae. Morphologically they are the same as the short cycle larvae; however they may remain in this dormant state under certain conditions for as long as two and a half years. In last season's work it was found that the age of the bolls had a direct bearing on the percentage of larvae that entered this state as follows:

Age of bolls when infested, days:	1-10	11-20	21-30	31-40	41-50
Percent of larvae entering diapause:	8.2	14.8	26.7	43.9	64.8

When the above larvae were removed from seed, they were placed in individual 3 ml. glass vials and allowed to spin up in a piece of paper. These vials were examined weekly and the larvae that had pupated were removed. Many of these larvae have not pupated yet, but the results to date are given below.

Age of bolls when infested, days:	1-10	11-20	21-30	31-40	41-50
Percent of larvae pupated to date:	83	60	43	30	60*

* Only five larvae of this boll age were obtained.

The results shown above seem to indicate that some substance in the older bolls may have a direct bearing on the resting larvae. Therefore, bolls of the same ages shown above are being collected and will be analyzed for water, protein, sugar, fat, and gossypal content.

Many workers have reported on the peak emergence of moths in the spring and considered this may be due to warm weather and increased moisture. Last fall a series of tests were begun in which different lots of resting larvae were exposed to constant temperatures of 68, 77, 86, and 90° F. and constant humidities ranging from 5 percent to 100 percent. These tests are incomplete so that final results can not be given; however, high temperatures and high humidities were found to be conducive to pupation. Surprising enough, large numbers of larvae held their diapause. Larvae held at low temperatures have been very slow in pupating regardless of humidity. From this single season's work on larval diapause, it would appear that there is a complex of factors that govern this phenomenon.

Approximately 60 percent of larvae collected from rosetted blooms last October are still in the resting stage. These larvae were held in the insectary at a practically constant temperature of 80° F. and approximately 60 percent relative humidity. Foreign entomologists working on the pink bollworm have stated that larvae developing in squares never enter the diapause. In previous experiments such pink bollworms developing in squares have not been found to carry over to the next cotton season in this area when placed on the soil in outdoor cages.

Studies of the reaction of pink bollworm moths to chemicals were given some attention during the winter. Among 87 chemicals tested as attractants or repellents, several were found to markedly reduce the number of eggs laid on the treated plant terminals; others noticeably increased the attractiveness of the plant for oviposition.

There is considerable advantage in knowing the extent to which newly hatched pink bollworm larvae move about on a plant before penetrating the fruit. It was found that when a large number of eggs were put on a boll that some of the larvae left the boll and later were found on another boll at least 16 inches distant.

Hibernation - Line Project ENT f3-6 (A. J. Chapman, L. W. Noble, Ivan Shiller, G. L. Smith, O. T. Robertson, and C. R. Parencia): The last issue of this series, "Pink Bollworm Information No. 2", gave a complete account of hibernation experiments for the winters of 1952-53 and 1953-54 at Brownsville, Port Lavaca, Waco, Greenville, Mount Pleasant, Lubbock, and Vernon, Texas, and at Chickasha, Oklahoma. Pink bollworm survival at the different localities varied widely and there was considerable difference between the two years. The highest survival during both years was at Waco. There was a rather large survival, 2% in 1952-53 and 6.6% in 1953-54, at the most northern point (Chickasha, Oklahoma). Of the four cultural treatments incorporated in the experiments, fall burial of infested bolls caused the lowest survival at localities with mild temperatures and heavy rainfall - that is, at Brownsville, Port Lavaca, Waco, Greenville, and Mount Pleasant. In the localities with colder winter temperatures - that is, at Lubbock, Vernon, and Chickasha, survival was lowest in bolls under conditions simulating standing stalks. At all localities fall burial decreased

survival below that for bolls that remained on the soil surface until buried in the spring. At all places except Brownsville survival was highest in bolls that remained on the soil surface throughout the experiments. These experiments are being repeated this year in the same localities.

Additional tests simulating certain cultural practices not included in the previous experiments were inititated last fall. These consist of treatments to determine effects of winter cover crops at Mount Pleasant, preplanting irrigation at Brownsville and Lubbock, and date of winter burial more closely simulating actual farm plowing date at Lubbock, Vernon, and Chickasha.

Tests are being conducted in bioclimatic cabinets to determine winter survival of the pink bollworm under conditions simulating the climates at Greenwood, Mississippi, and at Brownsville, Texas, the latter being for comparison with outside cage tests. The tests were begun in climates as of September 1 at Brownsville and November 1 at Greenwood using soils typical of the areas under test and simulated rainfall supplied as distilled water in amounts equal to and on the dates rain fell in the respective localities. There was an estimate of 445 larvae in each of three different cultural treatments for the respective localities based on the examination of samples at the time the bolls were placed in the cabinets. (See also Bioclimatic Studies).

The April 1 examination of bolls receiving no rainfall but otherwise kept under conditions simulating standing stalks in the Greenwood climate showed no pink bollworm survival in this environment. Also there has been no moth emergence to date from bolls on soil surface or buried 2 inches in the Greenwood cabinet; however, the season is still too early for concluding that there could not possibly be some emergence later. As was anticipated,

a considerable number of moths emerged in the Brownsville cabinet at various times during the winter. The season is not sufficiently advanced and the moth emergence records obtained to date from the other hibernation experiments are not sufficient for reporting results at this time.

Bioclimatic Chamber Studies - Line Project ENT 1-a-2-2 and ENT f3-6 (N. E. Flitters, P. S. Messenger, and L. W. Noble): A building has been constructed and bioclimatic chambers, together with other necessary equipment, installed in it from funds furnished by the U. S. Department of Agriculture. These facilities are to be used jointly for studies of the pink bollworm and citrus fruit insects. N. E. Flitters of the Fruit Insects Section and P. S. Messenger, employed by the State of California, are supervising the operation of these cabinets and conducting biological studies in cooperation with the pink bollworm research organization.

Bioclimatic chamber studies were initiated in November 1954. These investigations were the outgrowth of successful bioclimatic chamber studies conducted in Hawaii on the three economic fruit fly pests, the Oriental fruit fly (Dacus dorsalis), the Melon fly (Dacus cucurbitae), and the Mediterranean fruit fly (Ceratitus capitata). In this work the climatological conditions representative of certain selected agricultural sites in Florida, Georgia, Louisiana, South Carolina, Texas, Indiana, New Mexico, Arizona, and California, collectively representing almost 25 years of climate, were simulated. These Hawaiian studies, concluded in 1954, have revealed areas with climates potentially favorable, not favorable, or marginal, to the development of these fruit flies in the United States. This information is of vital significance should incipient infestations of these fruit flies ever be discovered in the continental United States.

Five bioclimatic chambers were constructed at the Center early in 1954 and the general design and work facilities are approximately the same as the chambers used in Hawaii, but the ideas for technical improvement gained in the fruit fly studies were incorporated in the new chambers.

By studying the reaction of the Mexican fruit fly to simulated conditions of climate representing selected environments in the United States, it should be possible to make reliable predictions concerning the ability of the insect populations to establish or maintain themselves successfully in the important fruit growing areas in the United States. Investigations will also be conducted on the length of diapause, rate of emergence, and mortality of the pink bollworm in normally infested cotton bolls when exposed to various conditions of climate and environments representative of winter conditions of such places as the Mississippi Delta, the Rio Grande Valley, and other important cotton producing areas. This avenue of investigation will include the duplication of cultural practices (in so far as possible) whereby the infested cotton bolls will be exposed on the surface of the soil, on standing stalks, and buried at various depths in the soil.

Current tests are being conducted in chambers simulating the climatological conditions of Greenwood, Mississippi, and Brownsville, Texas. The latter site is used as a means of comparison between outside cage tests and bioclimatic chamber results. Soils typical of the areas under test are contained in each chamber and simulated precipitation is accomplished through the application of distilled water in amounts equal to and on the dates rain fell in these respective localities.

The sites presently under simulation are (1) Riverside, Calif., (2) Chula Vista, Calif., (3) el Centro, Calif., (4) Brownsville, Texas, and

(5) Greenwood, Miss. An insectary operated under recognized quarantine standards is established in the bioclimatic chamber laboratory, and cultures of fruit flies are being maintained at levels that insure adequate production of all insect stages required to meet the experimental demands of the bioclimatic chamber studies.

In two of the Californian climates, Riverside and Chula Vista, the Mexican fruit fly (Anastrepha ludens) has been able to successfully reproduce but in spite of the recovery of progeny flies in the former site, the occurrence of high temperature resulted in total mortality before the F-1 generation became strong enough to perpetuate itself. The month of July at Chula Vista provided a striking example of the effect of temperature on the rate of insect development. In the early part of the month those flies that emerged had a total developmental period of approximately 90 days whereas in the latter days of the month, this period was only 58 days.

The temperatures simulated for El Centro, Calif., have not been satisfactory for the Mexican fruit fly to complete its pre-imaginal development.

The Brownsville temperatures ranged widely, however, in spite of these variations, fruit fly progeny were recovered intermittantly throughout the period. Suicidal emergence of adult pink bollworm moths took place rather predominantly during the earlier months of simulation, but recoveries waned appreciably towards the end of the latter weeks. Moth emergence reached a total nearing three hundred during the five-month simulation period. Under Greenwood, Miss., conditions, there was no emergence of fruit flies or pink bollworm moths. However, the pattern of low temperatures and comparatively high relative humidities make this study site particularly interesting. (see also "Hibernation").

Physiological, Morphological, Histological, and Biochemical Investigations - Line Projects ENT f3-14 and ENT f3-16 (E. W. Clark, D. S. Chadbourne, C. A. Richmond, and E. S. Vanderzant): Certain aspects of the investigations of the haemolymph of the larvae and pupae of the pink bollworm have been completed. Cytological studies of the haemolymph of the larvae and pupae have been finished and a manuscript is being prepared for publication. The results show that there is a difference in the differential cell counts between the long-stage and short-stage larvae as well as between larvae and pupae. Sugar analysis of the haemolymph of short-stage larvae were also carried out and three carbohydrates were found to be present.

In seeking a natural food source for the pink bollworm adult, chromatographic analysis of the extrafloral nectar of cotton were carried out. Six sugars were isolated but no amino acids or proteins. This would indicate that this nectar is definitely a possible food source as it is rich in carbohydrates, secreted throughout the cotton growing season and available in the microhabitat of the moth.

To date several hundred moths have been reared to the adult stage in culture tubes. At present, two diets are being used satisfactorily, one having cottonseed meal as a base and the other, peanut flour. Two aspects of the mass culture techniques are being studied. The first is an intensive search for a fungicide or fungistatic agent that will control molds even though certain sterile techniques are not used. The other is the search for a method of stopping or reducing cannibalism. Quite a number of moths have been successfully reared using mass culture techniques but it has been done on the basis of allowing 0.5 cubic inches of medium per worm to reduce cannibalism. This is rather a poor yield from the standpoint of available food as 0.5 cubic inches of medium should support four or more

larvae. Attempts have been made to develop a method that would effectively isolate the pink bollworm larvae in mass cultures. One-inch lengths of jumbo soda straws, filled with medium, appear very promising as they are easy to fill, withstand autoclaving and hold their shape well.

Studies on the nutritional requirements of pink bollworm larvae carried out at College Station by Dr. Erma S. Vanderzant showed that media having a diet with a protein-carbohydrate-fat ratio similar to that of a cotton boll of intermediate age, i.e. 16 to 20 days after flowering, was most satisfactory. In a diet high in protein and low in carbohydrates and fats the larvae developed slowly and pupated over a 5- to 8-week period. A new synthetic diet for the larvae was developed in which casein was substituted for egg albumen or cottonseed meal which had been used previously. Major attention was given to determining satisfactory environmental conditions and the effects on larval growth of varying quantities of dietary constituents. It was found that English peas provide the larvae with an adequate diet and serve as well as individual feeding units. Fresh peas were wrapped individually in absorbent cotton and put in a 500 ml. flask to a depth of 2 inches; then the plugged flasks were autoclaved. After cooling, washed pink bollworm larvae were put on the peas. Thirty and 37 normal larvae respectively were reared in each of 2 flasks. Eggs were obtained from the resulting females. This technique appears to have some possibilities for mass rearing.

Further research on the flotation method of segregating infested and non-infested cottonseed has been finished using heavily infested seed and this method apparently is not feasible. Solutions of specific gravities from 0.79 to 1.3 were tried with no successful separation.

Radioisotopes promise to be useful in studying moth migration and other experimental work. E. W. Clark attended the ORINS course at Oak Ridge in basic radioisotope techniques, and equipment has been obtained to utilize this experimental tool.

Biochemical investigations of the pink bollworm will be hindered, temporarily at least, by the absence of D. S. Chadbourne who resigned recently to return to Texas A & M College to continue graduate studies towards a Ph.D. in biochemistry.

Cotton Varietal Susceptibility to Pink Bollworm Damage - Line Project ENT f3-4 (Ivan Shiller and Cotton Breeders): Thirty-three hybrids of various species of Gossypium, furnished by plant breeders, were grown in the large cage at Brownsville where they were exposed to a heavy concentration of pink bollworm moths. Some of the plants have not as yet fruited sufficiently for making infestation records but none of those examined have showed any resistance to pink bollworm attack. These cottons, which were not damaged by the winter weather, will be continued under observation and some additional plantings are being made.

Alternate Host Plants of the Pink Bollworm - Line Project ENT f3-10 (Ivan Shiller, G. L. Smith, and Jack Sherrer): Further observations, during recent months, of some 40 species of malvaceous plants growing in the large cage at Brownsville has not shown any pink bollworm hosts not previously known. Some of the plants died during the winter and are being replanted Also a few more species are being added to the group under observation here, and the planting of a mallow garden for observation at Port Lavaca is underway.

Malva parviflora and Hibiscus lasiocarpus were found fruiting abundantly before cotton produced squares in the Port Lavaca area.

Fruiting buds were present on Malva parviflora as early as January. This plant has been found infested by the pink bollworm before the first cotton squares were available for propagating the insect.

A pink bollworm moth emerged on March 14 from Malvaviscus drummondii that was caged at Port Lavaca on October 31. This is the first time that the pink bollworm has been found to live through the winter on Malvaviscus drummondii. This is the tenth plant species, other than cotton, on which the insect is known to survive the winter in the United States.

The pink bollworm has been found to develop to maturity on a number of plants, including flax and some of the wild mallows, when eggs were placed on the fruiting forms or moths were caged on the plants without the choice of a preferable host. Such plants are not considered to be true hosts of the insect until they have been found infested under natural conditions or in the presence of cotton or other host plants. The plants known to meet these latter qualifications as pink bollworm hosts in the United States are listed below with an asterisk by those found to carry the insect overwinter.

Abutilon trisulcatum (Jacq.) Urban
Althaea rosea (L.) Cav. - Hollyhock
*Gossypium thurberi Todaro - Thurber Cotton
*Hibiscus abelmoschus L. - Muskmallow
*Hibiscus cannabinus L. - Kenaf
*Hibiscus cardiophyllus Gray
Hibiscus coccineus Walt. - Scarlet rosemallow
*Hibiscus esculentus L. - Okra
*Hibiscus lasiocarpus Cav. - Wooly rosemallow
*Hibiscus militaris Cav. - Scarlet rosemallow
Hibiscus mutabilis L. - Cottonrose hibiscus
Hibiscus rosa-sinensis L. - Chinese hibiscus
Hibiscus syriacus L. - Shrub althea
Hibiscus tubiflorus D.C.
Kosteletzskya althaeifolia (Chapm.) A. Gray
*Malachra capitata L.
Malva parviflora L.
Malvastrum coromandelianum (L) Garcke
Malvaviscus arboreus Cav. South American waxmallow

*Malvaviscus drummondii T. and G. - Drummond waxmallow
*Pseudabutilon lozani (Rosa) Fries - Lozano false abutilon
Sida cordifolia L.
Thespesia populnea (L.) Correa - Portia tree

The above list does not include pink bollworm hosts reported by other workers in foreign countries, but is restricted to the plants observed by the pink bollworm research staff in the United States.

Biological Control of the Pink Bollworm - Line Project ENT f3-2 (J. M. McGough and G. W. Angalet): Five species of parasites shipped from India through the Moorestown, New Jersey, laboratory were propagated for release in 1953-54. In addition to the rearing at Brownsville, some of the parasites were increased at Moorestown and forwarded via air for liberation. Releases were made in the Brownsville, Port Lavaca, and Eagle Pass area of Texas, and in Tamaulipas, Mexico. The Texas areas included 15 counties. During this period, 405 colonies were liberated. The following table gives the releases:

Species	Number parasites liberated		
	Texas	Mexico	Total
Apanteles angaleti	69,536	2,194	71,730
Bracon brevicornis	303,092	11,000	314,092
Bracon gelechiae	299,426	11,000	310,426
Chelonus sp. #1	18,493	--	18,493
Chelonus sp. #2	8,256	289	8,545
Total	698,803	24,483	723,286

A breeding stock of Bracon greeni was also received from India, but efforts to rear this parasite were not successful.

Attempts were made to determine if any of the parasites had become established. Although 9,891 pink bollworm moths emerged from bolls collected at 14 different liberation points, none of the imported parasites were recovered. No doubt the use of insecticides for cotton insect control

hindered propagation of the parasites. It is believed that the sampling to date has not been adequate for conclusions as to whether or not the parasites may have maintained themselves in low populations. G. W. Angalet, transferred to Brownsville in February, was assigned here to place greater emphasis on efforts to determine if any of the species have become established, including attempts to recover them either from cotton or other pink bollworm host plants as well as from insect hosts other than the pink bollworm.

The coccinellid, Chilomenes sexmaculata, was received from India in 1954. Attempts to rear this predator on Pseudococcus solani developing on potato sprouts have not been gratifying to date. However, it reproduced abundantly on aphids on cotton in the large screened cage at Brownsville. Nearly all of the adults released to date were collected from this cage. A total of 15,346 were liberated in Texas and Mexico as shown in the following tabulation.

Locality of liberation	No. of releases	No. of adults
Calhoun County	1	915
Cameron County	47	11,807
Maverick County	10	1,497
Willacy County	3	450
Torreon, Coah., Mexico	1	1,055
Total	62	15,724

In one field of sorghum, heavily infested with aphids where nearly 1,000 adult predators had been liberated about 5 weeks previously, eggs, larvae, pupae, and one adult were found in Cameron County. Further observations are necessary to determine if the predator maintains itself in the fields from one crop season to the next.

Insecticide Experiments - Line Project ENT f3-6: Pink bollworm insecticide experiments conducted in the Lower Rio Grande Valley and at Torreon, Coah., Mexico, in 1954 have been reported previously. Experiments conducted at Presidio and Port Lavaca, cage tests with soil insecticides, further laboratory screening tests, and tests with systemic insecticides used as a seed treatment for early-season insect control are discussed below.

Experiments at Presidio (O. T. Robertson): In the Presidio Valley, plots treated with DDT for pink bollworm control produced gains ranging from 548 to 1440 pounds of seed cotton per acre. Approximately equal control resulted from the use of 3.45 pounds of DDT at 10-day intervals and 1.59 pounds at 5-day intervals. DDT applied at 2.1 pounds per acre every seven days was a little more effective than 3.8 pounds applied at 14-day intervals. Dilan used at the same rates as DDT gave approximately the same degree of control as DDT. Strobane applied at 4 pounds per acre and endrin at 1 pound were less effective than DDT at 2 pounds per acre. Dilan did not control aphids and spider mites. Chlorthion, malathion, and methyl parathion in mixture with DDT were effective against aphids and spider mites. In a dosage test, malathion and methyl parathion gave good spider mite control at .5 and .2 pound per acre respectively, and the degree of control did not increase appreciably when the dosage was increased.

Many farmers in the Presidio area produced substantial gains from the use of insecticides. Eight growers who made 7 to 14 applications of DDT at 7-day intervals produced more than two bales per acre while others who used a smaller number of applications produced about one bale per acre.

Experiments at Port Lavaca (G. L. Smith and J. D. Sherrer): In the Port Lavaca area, drought conditions prevailed and although pink bollworm

infestation was high in some fields, gains from control with insecticides were low due to the short fruiting period. In one experiment the use of DDT mixtures almost doubled seed cotton yield and the lint sold for 34.5 cents per pound compared to 26.5 cents for plots treated with insecticides effective against the boll weevil but not against the pink bollworm. In another experiment, 9 applications of DDT-toxaphene mixture beginning when cotton was in the presquare stage, resulted in the production of cotton that sold for 28.5 cents per pound whereas pickers refused to harvest plots treated with toxaphene or endrin alone and the crop was a total loss due to pink bollworm damage. Three experiments showed considerable reduction in pink bollworm infestations from preboll applications. High and low gamma BHC dusts were equally effective for cleanup of early season aphid infestation in the Port Lavaca area. Good spider mite control was obtained with demeton and parathion at 0.25 pound per acre while sulphur at 20 pounds per acre was not so effective. The mite species involved was tentatively identified as Tetranychus desertorum. A farm treated with BHC-DDT-sulphur, primarily for boll weevil control, produced about 1-1/3 bales per acre while a similar adjacent untreated farm produced 1/3 bale per acre.

Seed treatment with systemics (R. L. McGarr and G. L. Smith): Control of the insect that cause early-season damage to cotton, as well as any other measure conducive to setting an early crop and hastening maturity, is considered beneficial in pink bollworm control or in evading damage by this insect. Experiments with systemic insecticides used as a seed treatment for control of early-season insects are underway. Experiments at Brownsville have been carried out to date in accordance with plans for a series of uniform experiments to be conducted at the various stations of

this Section. In addition to the uniform small-plot experiments as planned for the various stations, other experiments on large plots are underway at both Brownsville and Port Lavaca, the latter not having progressed sufficiently as yet for reporting results.

In these experiments, seed treatments with compound 3911 at 0.5 and 1 pound per acre and compound 12008 at 1 pound per acre were compared with conventional insecticide applications and untreated check.

In all of the Brownsville experiments the cotton seedlings emerged about a week after planting. Germination and plant growth appeared to be normal with no significant differences between treated and untreated plots. The aphid population did not build up to any appreciable extent in most of the tests until the plants were about 6 weeks old or near the end of the effective period of the systemic treatments. At that time, however, all of the treated plots showed considerably lower aphid populations than the untreated checks. Thrips and spider mite infestations were negligible on all the plots - these pests being absent on too few to show conclusive results.

Soil Treatment with Chemicals (Ivan Shiller): Eleven chemicals were used as soil insecticides or fumigants against pink bollworm in open bolls. The experiment was designed to determine if crop residues might be treated immediately ahead of the plow either with a spray machine or an applicator attached to a tractor plow to kill larvae that otherwise would live through the winter. The bolls were treated and buried in cages and the treatments were evaluated by moth emergence records. The 7 more effective treatments caused reductions in moth emergence ranging from 97 to 36 percent. These 7 chemicals are listed in the order of their effectiveness at the rates used as follows: Endrin at 8 lbs. per acre, parathion at 10 lbs.,

CBP at 100 gals., aldrin at 10 lbs., heptachlor at 20 lbs., gamma BHC at 6 lbs. of gamma, and EPN at 16 lbs. per acre.

Laboratory and Cage Tests at College Station (E. E. Ivy): In laboratory tests, compounds 17147 and 16259 were more toxic to pink bollworm moths than DDT when used at one-fourth the dosage at which DDT was used. Compound 16259 at 0.75 pound per acre completely prevented oviposition. Aroclor 5460, mixed with compounds 0-20738 and L-13/59, did not increase the residual toxicity of these compounds. In large field cages over growing cotton, compound 17147 gave better control of the pink bollworm at 0.5 pound per acre than DDT at 4 pounds.

Laboratory Studies at Brownsville (W. L. Lowry and C. H. Tsao): Additional equipment for laboratory application of insecticides to test insects and plants has been constructed and installed. This and other equipment is currently being used, making it possible to test insecticides in larger numbers and more efficiently.

A total of 34 chemicals have been tested at Brownsville for contact action on pink bollworm. In preliminary laboratory tests thus far, eight new chemicals, compounds 17147, 16644, DDVP, 0-20782, ET-14, ET-15, 16574 and R-6199, have been found to be more effective against pink bollworms than DDT. Some of these chemicals were also very effective in killing boll weevils. When combined with a so-called "extender" (aroclor 5460) in proportions of 1 part of insecticide to 4 parts of extender, a single application of DDVP continued to kill 100 percent of pink bollworms for 31 days. Several other new chemicals were outstanding in their insecticidal action as contact insecticides and further tests are currently underway.

A small-scale field plot experiment designed to test the systemic effect of 7 different chemicals against the pink bollworm under natural

conditions, is currently underway. This test consists of 24 adjoining plots each of which is 4 rows wide and 33 feet long. Each plot is subdivided equally and all chemicals will be applied at rates of 8 and 16 pounds per acre, respectively. Chemicals have already been or will be applied in three different manners as follows: (1) Soil application at a depth of approximately 4 inches with seed planted directly over the chemicals, (2) side dressing at a depth of approximately 4 inches on either side of the rows about the time plants begin to fruit, and (3) foliage application when fruiting begins. The first phase of this experiment has been carried out according to plan with no apparent chemical injury to the young plants. Except for slight damage due to earlier unfavorable weather conditions, the plants are growing well. Up to the present time, injurious insect populations have been low in all plots but it is anticipated that later there will be ample infestation to determine whether or not these chemicals will be taken up systemically by the plants, translocated to the fruiting forms, and thus protect them from attacks by the pink bollworm. Preliminary laboratory tests have shown that some boll weevils were killed when allowed to feed on plants taken from certain plots which had received soil treatment 71 days earlier. Other data will be obtained as the experiment progresses.

Light Traps - Line Project ENT f3-17 (P. A. Glick and W. J. Eitel): A light trap operated on the laboratory grounds at Brownsville showed that pink bollworm moths were active during the winter. The number of moths collected in this trap each month was as follows: November, 45; December, 2; January, 2; February, March and April, none. Four additional traps were set up in the Brownsville area late in January and no pink bollworm moths were taken in these up to May 1.

An experiment is underway with a light trap operated in a 40 x 60-foot cage containing fruiting cotton to determine the pink bollworm buildup in it as compared to that in a similar check cage without a light trap. One moth was caught in April before the cage was reinfested with 126 moths on April 19-20. Seventeen moths were taken in the trap soon after the liberations were made and several subsequently.

In cooperation with the Farm Electrification Section, Texas Sub-Experiment Station No. 19, and several farmers, an effort is being made to evaluate the effect of light traps on insect damage to various crops. About 160 electrocuter traps have been installed in an isolated farm area of about 3,000 acres at Batesville, Texas. Three collection traps have been located in this area to determine the number and kinds of insects present. One collection trap is set up in a similar farm area where no traps are in use, and another area has been selected where no traps will be operated. Infestation of various insects on the several crops are being taken periodically with special attention to cotton pests. A history of the fields involved has been obtained and records will be kept on the use of insecticides and other factors likely to affect infestations and yields.

Relation of Cultural Practices to Pink Bollworm Control - Line Project f3-3 (L. C. Fife, Waco; G. L. Smith, Port Lavaca; Staff at Brownsville): Pink bollworm infestation in the Lower Rio Grande Valley has been on the down trend since the peak reached in 1952, primarily due to thorough destruction of cotton stalks by the end of August. It appears that the carry-over to the 1955 crop will be as low or lower than in recent years. Rains hindered the destruction of volunteer cotton in September and October, and in the fields of some small growers on the Mexican side of

the river, cotton continued to produce squares until the last part of January. However, general observations indicate that the presence of this cotton did not result in a serious propagation of pink bollworms to live through the winter due to the fact that larvae developing in squares in this area are prone to pupate before the next crop season, and the fact that few bolls developed because of boll weevil attack on the squares. The fall rains favored pupation of many larvae in the crop residue instead of their remaining in the resting stage until spring.

In the Port Lavaca area, fields in which stalks were plowed under the middle of September showed a much greater reduction of overwintering larvae than fields where stalk cutting and plowing was delayed until the October 10 deadline.

In 16 fields in which comparative records of winter and spring pink bollworm populations were made in the Waco area, it was found that the number of larvae per acre was reduced by 70 percent during the time that elapsed between the two inspection periods. There was, however, very little difference in the number of live larvae per pound of debris between the winter and spring samples. The reduction or disappearance of the debris between the two samplings averaged 74 percent. Bolls or locks that had been buried for a considerable time at the spring inspection were fairly well rotted while those on the soil surface were pretty well intact. There was considerably less crop debris and smaller pink bollworm population in fields in which stalks were destroyed in August or September than on later dates. In one field in which the stalks were destroyed August 16 and the land bedded shortly afterwards, there had been a heavy green boll infestation but the mid-winter samples failed to show any live pink bollworms.

Methods of Destroying Pink Bollworms in Cottonseed, Seed Cotton and Gin Waste - Line Project ENT f3-15 (O. T. Robertson, D. H. Currie, A. J. Chapman, C. A. Richmond, and C. N. Husman)*: An elaborate series of tests were made at the Mesilla Park Ginning Laboratory in the spring of 1955 to determine pink bollworm mortality caused by various ginning set-ups, fans for handling gin trash, mechanical treatment of seed, delinting, and oil milling processes. Moth emergence records from some of these tests are not complete and hence results can not be reported in full.

Previous research has already discovered some practices that increase the kill of pink bollworms during the ginning process. It has been found that rather simple ginning equipment kills about 60 percent of the pink bollworms as the cotton passes through the gin, and very elaborate equipment may kill practically 100 percent.

Experiments conducted in 1954, at Mesilla Park and at many gins in Texas showed that trash fans were effective in killing pink bollworms. Based on this research the Pink Bollworm Control Project on January 21, 1955, issued requirements for use of single fans for treatment of gin trash to permit its local use as stock feed and for soil improvement. This action was received with enthusiasm by ginners and farmers.

Preliminary tests were conducted at an oil mill at Brownfield, Texas, during March 1954. In these tests live worms were found in motes that had not passed through the mote beater but none after passing through the

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*Acknowledgment is made of the equipment placed at our disposal at the U. S. Cotton Ginning Branch Laboratory at Mesilla Park, N. M. and of the engineering assistance furnished by Messrs. V. L. Stedronsky and David M. Alberson and others of that Branch. Assistance in some of the ginning, delinting and milling experiments and in the examination of samples was given by members of the Pink Bollworm Control Project.

beater. No live worms were found in linters, lint beater waste, seed hulls and meats.

The promising results obtained in these preliminary oil mill investigations in 1954 led to tests at Mesilla Park in 1955 to determine the kill of pink bollworms in oil mill linters, motes, and hulls treated with standard straight blade fans. Three different fans were used and the tip speed of the blast wheel ranged from normal speed at which such fans are operated at oil mills to the maximum speed considered safe for their operation. Heavily infested cotton seed, ginned on a roller gin to prevent injury of the larvae, were mixed with the oil mill products. They were added separately to linters, motes and hulls before passing through the fans. Conditions of the experiments highly favored survival of the pink bollworm as compared to normal oil mill operations. The infested seeds were added to the oil mill products at a rate much greater than would be found under normal conditions. Further, the infested seeds did not pass through linter saws, beaters, and other machinery, normally used in milling, before being used in the fan tests. The larvae were in far better physical condition to withstand the impact of the fan than had they passed through the usual milling machinery. Results were favorable toward accomplishing complete kill with a specified kind and speed of fan. The samples examined after treatment contained 3,432 larvae and in only one of seven experiments was there any survival. One larvae escaped being killed, but in the same treatment all were killed in the two other replicates. The surviving larva was in a treatment with the largest fan (27-inch wheel) run at the lowest speed (1606 RPM with a tip speed of 11,350 RPM). Most mills already use fans, such as the ones used in these experiments, in conveying linters, motes and hulls.

An experiment was conducted in which 1,000 pounds of infested cotton seed were run through a commercial acid delinting plant at Pecos, Texas, and samples examined to determine pink bollworm mortality due to the delinting process. Samples were collected at the time of delinting on December 13 and examined during the period from about the middle of January to the middle of March. Examination of samples of untreated seed showed an average of 23 worms per pound. There was no survival in 62 pounds of seed examined which received the complete process of acid delinting, washing, and hot-air drying. Five larvae were found to survive in 18 pounds that received the acid and washing treatment but was dried at normal air temperature instead of being given the usual hot-air treatment.

Samples of infested cotton seed taken at gins in several localities and not heat sterilized were stored in the usual way in the respective localities then shipped to Brownsville for planting. The seed was planted at a high rate per acre and covered with cages. Up to April 28, only one pink bollworm moth had emerged.

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"The Pink Bollworm Menace" by F. C. Bishopp (Agr. Chem., Vol. 10, No. 2, pp. 49, 125, Feb. 1955).

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"Colonization of Imported Pink Bollworm Parasites in the United States and Mexico, 1937-54" by J. M. McGough and L. W. Noble (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"A Summary of the Exploration for Parasites of the Pink Bollworm in India" by George W. Angalet (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"Overwintering of the Pink Bollworm in Texas and Oklahoma - 1952-1954" by A. J. Chapman and L. W. Noble (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"Five Years Insecticide Tests for Control of the Boll Weevil and Other Cotton Insects in the Lower Rio Grande Valley" by R. L. McGarr (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"Attraction of the Pink Bollworm Moth to Radiation of Lamps in the Ultraviolet and Visible Spectra" by P. A. Glick, J. P. Hollingsworth, and W. J. Eitel (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"Flight Studies of the Pink Bollworm Moth" by P. A. Glick (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"Miscellaneous Studies on the Haemolymph of the Pink Bollworm Pectinophora gossypiella Saunders" by Edgar W. Clark and D. S. Chadbourne (Second Annual Meeting of the Entomological Society of America, Houston, Tex., Dec. 6-9, 1954).

"The Need for More Effective Defoliants and Desiccants in Pink Bollworm Control" by F. C. Bishopp (talk presented at Ninth Annual Beltwide Cotton Defoliation Conference, Memphis, Tenn., Jan. 13-14, 1955).

"The Insect Menace and Development of Entomology" by F. C. Bishopp (talk presented at Second Annual Agricultural Chemical Conference, Lubbock, Tex., Feb. 1-3, 1955).

"Progress Report on Pink Bollworm Research" by F. C. Bishopp (talk presented at Oklahoma Cotton Ginners' Association, Oklahoma City, Okla., Feb. 23-24, 1955).

"Effects of Insecticides on the Properties of Cotton Fibers and Seeds" by F. C. Bishopp (Southern Agricultural Experiment Station Collaborators' Conference, New Orleans, La., Mar. 21-23, 1955).

"Collecting Insects by Airplane" by P. A. Glick (South Texas Regional Meeting, Texas Academy of Science, Brownsville, Tex., Apr. 15-16, 1955).

"History of the Origin and Distribution of the Pink Bollworm" by M. J. Lukefahr (South Texas Regional Meeting, Texas Academy of Science, Brownsville, Tex., Apr. 15-16, 1955).

"Bioclimatic Cabinet Studies on the Mexican Fruit Fly and the Pink Bollworm" by N. E. Flitters (South Texas Regional Meeting, Texas Academy of Science, Brownsville, Tex., Apr. 15-16, 1955).

"Progress on Pink Bollworm Research" by F. C. Bishopp (South Texas Regional Meeting, Texas Academy of Science, Brownsville, Tex., Apr. 15-16, 1955).

"Two New Phosphate Insecticides for Cotton Insect Control" by E. E. Ivy, J. R. Brazzel, A. L. Scales, and D. F. Martin. Jour. Econ. Ent. (In Press).

"Behavior of Pink Bollworm Larvae" by J. R. Brazzel and D. F. Martin. Jour. Econ. Ent. (In Press).

"The Pink Bollworm as a Factor in Cotton Boll Rots" by J. R. Brazzel. Plant Disease Reporter (In Press).

PERSONNEL

Name	Title	Assignment
F. C. Bishopp	Coordinator, Pink Bollworm Research	
	BROWNSVILLE, TEXAS	
S. E. Jones	Entomologist	In administrative and technical charge of Brownsville Laboratory and sub-laboratories and in technical charge of all pink bollworm research conducted in the Southwest by the Cotton Insects Section
A. J. Chapman	Entomologist	Assistant in charge
L. L. Borja	Clerk-Typist	Clerical
E. W. Clark	Entomologist	Physiological, morphological, histological, nutritional, biochemical research
W. J. Eitel	Entomologist	Light trap investigations
P. A. Glick	Entomologist	Light trap investigations and moth migration studies
R. Guerrero	Clerk-Typist	Clerical
C. N. Husman	Equipment Engineer	Designing, adapting, and maintenance of equipment; studies of pink bollworm mortality at the gin
W. L. Lowry	Entomologist	Toxicology laboratory tests
M. J. Lukefahr	Entomologist	Pink bollworm biology studies; repellents and attractants
R. L. McGarr	Entomologist	Insecticides, field inspections and other program duties
J. M. McGough	Entomologist	Pink bollworm parasites
L. W. Noble	Entomologist	Reports and research program duties
C. A. Richmond	Entomologist	Nutrition studies; insecticide tests
Ivan Shiller	Entomologist	Insecticides, hibernation experiments, host plants, and varietal susceptibility to pink bollworm attack
E. O. Schunter	Clerk-Typist	Clerical
M. A. Taylor	Adm. Assistant	Fiscal administrative
C. H. Tsao	Entomologist	Toxicology laboratory tests
O. L. Walton	Entomologist	Ginning studies
F. B. Weeks	Clerk-Typist	Clerical
J. C. Gonzalez	Laborer-Unalloc.	Labor as assigned
M. Marroquin	Laborer-Unalloc.	Labor as assigned
D. Mayans	Laborer-Unalloc.	Labor as assigned
	COLLEGE STATION, TEXAS	
E. S. Vanderzant	Biochemist	Nutrition, artificial rearing media

LUBBOCK, TEXAS

Name	Title	Assignment
O. T. Robertson	Entomologist	In charge of sublaboratory, hibernation experiments, light trap investigations and ginning studies

PORT LAVACA, TEXAS

G. L. Smith	Entomologist	In charge of sublaboratory, hibernation and insecticide experiments, host plant studies
T. P. Cassidy (Part-time)	Entomologist	Ecology

TORREON, COAH., MEXICO

C. S. Rude	Entomologist	Insecticide experiments and studies of pink bollworm infestation level in the area

WACO, TEXAS

L. C. Fife	Entomologist	Pink bollworm hibernation and cultural control studies
J. W. Davis	Entomologist	Hibernation experiments, light trap investigations and insecticide experiments

PERSONNEL ASSIGNED BY STATES

ALABAMA

J. A. Griffin	Entomologist (Brownsville)	Biological studies; attractants and repellents

ARKANSAS

J. D. Sherrer	Entomologist (Port Lavaca)	Insecticide experiments, host plant and attractant studies

LOUISIANA

J. R. Brazzel (Part-time)	Entomologist (College Station)	Plant resistance

TEXAS

Name	Title	Assignment
J. C. Gaines (Part-time)	Entomologist	Head, Dept. of Entomology, Texas Agricultural Experiment Station
W. J. Magee	Entomologist (College Station)	Insecticides, sprayers, dusters, stalk cutters, defoliants and growth inhibitors, production practices
M. G. Davenport	Agricultural Eng. (College Station)	Sprayers, dusters, stalk cutters
S. P. Johnson (Part-time)	Plant Pathologist (College Station)	Defoliants and growth inhibitors, production practices
G. P. Wene (Part-time)	Entomologist (Weslaco)	Insecticides, sprayers, dusters, stalk cutters